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UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

Summary Review of Monthly Reports*
for
SOIL CONSERVATION SERVICE RESEARCH**
MARCH 1948

EROSION CONTROL PRACTICES DIVISION

Establishing New Vineyards - John Lamb, Jr., Ithaca, New York.-
"An inspection was made of young vineyards planted across the slope on land with slow internal drainage. The soils were Volusia, Mardin, and related series. Where the rows happened to have a slope that encouraged the water to move off, the growth was usually good. Where the water accumulated, it was equally bad. The drainage over-shadowed any difference in fertilizer treatments. It was apparent here, as usual, that successful erosion control means water control. Drainage and erosion control are closely related problems. To be effective each grape row must be laid out with a definite grade. Land levelling may be necessary in order to prevent sharp curves. If this is not practical, it may be best to abandon the site."

Efficient Use of Manure for Erosion Control at Marcellus - G. R. Free, Marcellus, New York.-"The data from this experiment at Marcellus were recently summarized for publication. Over a 4-1/2 year period, total soil and water losses under the 4 treatments were as follows:

Treatments	Surface run-off, inches	Soil loss, tons per acre
Low-rate application plowed under	27.4	31.1
High-rate application plowed under	26.4	19.5
Low-rate application as top dressing	19.5	11.0
High-rate application as top dressing	17.5	4.5

"A given quantity of manure used as a top dressing saved much more soil and water than did double that quantity plowed under. The difference in effect on crop yields over a period of 5 years has not be significant. The present level of soil organic matter appears to be more closely associated with method of application and the degree of erosion than with the amounts of manure applied. The benefits of top dressing with farm manure both on crop yields and on conservation of soil and water persist to a marked degree."

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** All research work of the Soil Conservation Service is in cooperation with the various State Experiment Stations.

Winter Grazing Crops - B. H. Hendrickson, Watkinsville, Ga.-"The following winter grazing crops in various combinations have supplied substantial amounts of upland grazing during the 5-month frost - to - frost 'winter grazing season' ending March 31:

"Oats, ryegrass, Kentucky fescue grass, orchard grass, alfalfa, Ladino clover, crimson clover, manganese bur clover, button clover and smooth vetch.

"Caley peas made such slow growth during the past winter that they had supplied only scanty grazing by March 31."

Soil Erosion Investigations - "Soil erosion investigations, with primary objectives of determining soil detachability and the protective values of grass and mulch covers, were started in late February.

"To determine detachability (D_2), samples of the soils are exposed to controlled (artificial) rainfall along with samples of a standard sand. The detachability is then computed by dividing the soil splash by the splash from the standard sand. In addition to testing soils on the Amarillo station, a number of other soils from points throughout the region were tested. These have been found to vary from about 0.20 for a highly resistant soil, to approximately 0.80 for a soil that is easily detached.

"Some work has been done on obtaining infiltration capacity curves of these soils when not protected by crops or mulch covers. This phase of the work is just now getting underway.

"Some few tests were recently made of the protective values of different range covers (values of R). This work, like that on the infiltration, has not reached a conclusive stage. However, in the tests thus far completed, it has been found that values of 'R' have varied from about 2.4 for very poor range to 240 for an excellent range."

Land Rest in Relation to Soil and Water and Soil Aggregation - O. R. Neal, New Brunswick, New Jersey.-"Numerous studies at different locations have shown the conservation effectiveness of land resting, crop rotation with grass-legume mixtures, and organic matter applications to the soil. At Marlboro during 1947 land in tomatoes following other clean cultivated crops lost 5 times as much soil and 6 times as much water as did land in tomatoes following a timothy and clover sod. Such results have been obtained repeatedly. We know a great deal about the effect of such practices on conservation, but know only a little about the exact mechanism involved. Obviously the physical condition of the soil has been altered by the resting treatment. The changed physical condition has increased the rate and amount of water absorption, thus reducing runoff and erosion.

"In an effort to measure these physical conditions directly, determinations of the percentage aggregation of silt and clay particles have been made. On the tomato areas cited above, 55 percent of the total silt and clay content was in aggregates larger than silt on the areas of high soil and water loss. On the areas of low loss, 70 percent aggregation was found. The difference appears to be too small to account for the rather large differences in runoff and erosion that occurred. This may be a result of

the procedure followed in determining the aggregation, or, of course, may indicate that aggregation of silt and clay is not a reliable indication of physical conditions affecting conservation. Much more work is needed along these lines."

Soil Loss, Corn Versus Soybeans - Dwight D. Smith, Columbia, Missouri.-"Soil losses under soybeans were determined for the same period as for corn (April 27 to October 7). In this period drilled soybeans have allowed as an average for two sequences about 85 percent as much erosion as corn when they followed the same crop. The erosion under drilled beans, as an average of available data from Columbia, Bethany, and McCredie, was 70 percent of that under beans in 42 inch rows and cultivated."

Land Class and Phosphate Application in Relation to Winter Killing of Oats - J. R. Johnston, Temple, Texas.-"Low temperatures of 14° and 15° F on March 11 and 12 did severe damage to spring legume seedlings and to winter oats. Detailed observation and study has shown that the preceding crop and phosphate fertilization exerted considerable influence on winter killing of oats during these low temperatures. The data obtained from this study are shown in Table 1. Study of these data bring out the following interesting points: (1) Oats following cotton or corn (with or without phosphate fertilization on class I land were only slightly damaged; (2) Oats following cotton on class II land were 47 percent killed - phosphating reduced this kill to 16 percent; (3) oats following corn on class II land were 11 percent killed - phosphating reduced this kill to 4 percent; (4) oats following cotton and corn on class III land were killed 65 and 52 percent respectively, whereas phosphated oats following the same crops on the same land were killed 10 and 8 percent respectively.

"These reactions will be watched for closely in coming years. If these data are further varified in subsequent years they would have definite bearing on soil and crop management in this area. These limited data would indicate that oats may safely follow either cotton or corn on class I Blackland and without phosphate fertilization. On class II land, however, oats should follow corn unless phosphated irregardless of the crop they follow if they are to be cold hardy.

"Many farmers in the area have reported that their phosphated oats stood the freeze and that the non-phosphated ones did not. Low applications of 100 pounds 20 percent superphosphate per acre in the drill with the seed was sufficient to instill the necessary 'cold hardiness'.

Effect of preceding crop and phosphate fertilization on winter hardiness of oats growing on three classes of Texas Blackland. (1).

Preceding crop	Fertilization of oats	Class of land		
		I	II	III
		% kill	% kill	% kill
cotton	none	7	47	65
cotton	phosphate	4	16	10
corn	none	7	11	52
corn	phosphate	7	4	8

(1) Winter hardiness expressed in percent of oats killed by 14° and 15° F temperatures of March 11 and 12, 1948. Data for the no fertilizer treatments are averages of 3 replications. Data for the phosphate treatment (200 lbs. 20% superphosphate/A in drill with oats) are averages of 2 replications.

"In another rotation experiment without phosphate fertilization class II, Houston Black clay soil, it was observed that on 9 plots of oats following cotton the average kill of oats was 66.5 percent, whereas on 15 plots of oats following corn the averages killed was 21.2 percent."

Phosphate and Potash Applications Reduced Broomsedge in Sericea Lespedeza Stands - E. C. Richardson, Auburn, Alabama.-"In April 1944, a sericea planting was made on Cecil sandy loam for the purpose of studying the effects of fertilizer on yield of hay, population of sericea plants and population of broomsedge. Preparation of soil consisted of breaking and harrowing to a good seedbed. After the land settled it was scarified with a section harrow and seedings were made on the surface at the rate of 40 pounds of sericea per acre. Fertilizer applications were made on the surface usually before growth started.

"Two cuttings of hay were made annually in 1945, 1946, and 1947. The first cutting was made usually in late May or early June and the second one in late July or early August. In making the sericea population study, one or more areas one square yard in size were excavated in each treatment. Plants per square yard were counted, weighed and calculated to a per acre basis. Where the broomsedge was thick, counts were made by square yard area. Where it was thin, counts were made on the entire plot. Periodic determinations will be made to determine the change, if any, in the sericea population, size of plant, and broomsedge population.

Results

"The greatest total number of sericea plants per acre occurred on the no treatment area, and on those receiving 200 pounds of phosphate. Plants on the above areas were smaller and were feeding in a zone 12 to 15 inches deep. Plants in the other areas were larger and were feeding in a zone 18 to 24 inches deep; however, the majority of the roots were found in the first fifteen inches of the soil. Broomsedge was becoming thick on the plots which received no fertilizer treatment. It appears now that sedge will dominate the check areas in another year or so. Where 400 pounds of superphosphate was applied either alone or in combination with muriate of potash, there was only an occasional sedge plant present. Results are shown in the following table.

Average Number of Sericea Plants, Weight of Plants and Number of Broomsedge plants Per acre.

Plot No.	Fertilizer Treatment	Average No. of plants per acre	Average Wt. of plants per acre	Average No. of sedge plants per acre
1	No fertilizer	1,047,860	10,890	106,480
2	200 S every year	1,166,440	14,520	2,800
3	400 S every year	1,050,280	13,310	615
4	400 S every year, 200 K	895,400	14,520	350
5	400 S every year, 100 K	723,580	16,940	50
6	400 S every year, 200 K, 4000 L	878,460	12,100	165
7	800 S every 2 years	798,600	15,730	750
8	400 S every 2 years	885,720	15,730	1,600
9	No fertilizer	1,350,360	14,520	96,800

S = Superphosphate; K = Muriate of potash. Fertilizer was applied on the surface usually before growth started.

Corn Yield In Relation to Land Management and Tillage Practices -
F. L. Duley, Lincoln, Nebraska.--"The corn yield moisture samples have been completed, and the 1947 yields are shown in the accompany table. The yields were the lowest since 1941. This low yield seemed to have been due not so much to lack of moisture or to available nitrogen, but probably more to hot dry weather at time of pollination.

Corn Yields

Plots	Rotation	Yield--Bu. per acre		
		Plowed	Stubble	Mulched
<u>Lincoln</u>				
25-I-E	Corn after s.clover 1 year	17.4		21.3
McCartney Field	Corn after oats and s.clover 1 yr.	38.6		38.5
24-IV-E	Corn, corn, after 2 yrs. s.clover	12.3		13.5
24-IV-W	S.clover 2 yrs., sorghum, corn	22.1		22.3
23-VIII	Corn after 2-yr. s.clover	25.8		27.9
23-VII	1-yr. s.clover, corn, corn	10.5		9.5
23-VII	S.clover 1 yr., sorghum, corn	23.9		21.5
23-V	S.clover 2 yrs., wheat, corn	28.3		27.5
B IV	Brome sod, corn	19.5		20.8
B III	Sod, corn, corn	11.0		11.6
22	Four legumes	24.5		23.6
	Mean	21.3		21.6
<u>Hastings</u>				
3-A	Sweetclover 1 yr., corn	19.5		22.8
3-B	Corn after oats, no legume	5.7		8.6
I-IW	S.clover 2 yrs., corn, corn	15.2		23.2
	Mean	13.5		16.2

"In nine tests from 1943-1947 the practice of subtilling land in the fall, in preparation for corn, increased the yield from 47.4 bushels on the spring plowed land to 54.2 bushels on the fall plowed land."

Stubble Mulch and Strip Cropping in Relation to Control of Wind Erosion - Torlief S. Aasheim, Havre, Montana.--"On March 22 a severe wind storm occurred in the vicinity of Havre. The wind velocity averaged 24.4 miles per hour over a 24 hour period on the two foot anemometer. This is the highest average velocity for a 24 hour period on record at the North Montana Branch Station. Records at the Station date back for 31 years. This storm caused a good deal of soil blowing particularly on block fallow. Protection offered by strip cropping was evident in a number of instances but fallow in strips as narrow as ten rods failed to hold on some fields. In most instances observed where stubble mulch was practiced, and the fallow was in strips there was very little soil movement but stubble mulch in block fallow definitely did not prevent soil drifting. Two block fallow fields were observed side by side near Gilford, one was black top fallow and the other was stubble mulched. The stubble mulched field had drifted much less than the black top fallow as evidenced by the accumulation of soil in the

borrow pit along the side of the road. Next to the black top fallow field the borrow pit was nearly full and next to the stubble fallow it was not over one fourth full. The black-top block was still sifting lightly on April 6 with only a light wind whereas the stubble mulched block apparently had not moved since the intense winds of March 22. On the heavier soils observed black top fallow seemed to hold pretty well when farmed in strips. On these heavier soils clods are quite effective in controlling wind erosion but clods are nearly impossible to maintain on the lighter soil types. Our observations indicated that:

1. No type of cultivated fallow held in this area when it existed in blocks. Only strip fallow was able to resist soil drifting. Width of strips which were effective varied with soil type.
2. Not all strip fallow was effective in controlling wind erosion. On the heavier soils that had a cloddy or stubble mulch wind erosion was effectively controlled. On the lighter soils where it is impossible to maintain clods, stubble mulch in addition to stripping was most effective in keeping soil drifting at a minimum.
3. North-South strips were much more effective than strips running East and West. Westerly winds are of most common occurrence in this area and the storm of March 22 was not an exception."

Stubble Mulch Tillage Increased Phosphorous Content of Wheat -
C. L. Englehorn, Fargo, North Dakota. - "Phosphorous determinations were made by standard colorimetric procedure on a composite sample of wheat obtained from each of the three replicated plots of each tillage practice involved and the results calculated in percent on the moisture-free basis. As in the case of protein, the differences in phosphorous content were not great, but in each case it was higher in the crop produced under stubble mulch tillage than plowing. Thus stubble mulch tillage for continuous wheat at Edgeley resulted in phosphorous content of .501 percent as compared to .472 percent for wheat on plowing. Tillage with the field cultivator and with the disk resulted in .501 and .492 percent respectively. Similar results were obtained at Langdon where the percent of phosphorous ranged as follows: .383 for tillage with the field cultivator, .371 for stubble mulch tillage, .364 for tillage with the oneway disk and .361 for plowing. Under summer fallow wheat from stubble mulch fallow had the highest and from plowed fallow the lowest phosphorous content at both Edgeley and Langdon.

"Apparently tillage has affected both the protein and the phosphorous content of the crop. However, whereas stubble mulch tillage has resulted in a higher phosphorous content, it has resulted in a lesser protein content than plowing.

"Whether the percent of phosphorous in the wheat crop is a result of the effect of tillage on available supply has not yet been determined."

Percent of phosphorous in wheat according to the method of tillage used for seedbed preparation and for summer fallow at Edgeley and Langdon, 1947.

Tillage	Percent Phosphorous			
	1	2	3	Average
Continuous cropping, Edgeley				
Moldboard plow	.450	.468	.497	.472
Burn residue, no tillage	.488	.477	.454	.473
2 ton straw, stubble mulch	.481	.517	.487	.495
Stubble mulch	.503	.490	.510	.501
Field cultivator	.524	.484	.494	.501
Disk	.500	.479	.496	.492
Continuous cropping, Langdon				
Moldboard plow	.348	.383	.353	.361
Field cultivator	.399	.388	.362	.383
Oneway disk	.338	.357	.397	.364
Stubble mulch	.375	.387	.350	.371
Summer fallow, Edgeley				
Moldboard plow	.456	.464	.496	.472
Field cultivator	.508	.477	.471	.485
Stubble mulch	.512	.490	.518	.507
Summer fallow, Langdon				
Moldboard plow	.337	.341	.391	.356
Field cultivator	.359	.348	.369	.359
Stubble mulch	.375	.371	.352	.366

Crop and Livestock Production on Sand and Sandy Loam Soils - H. O.

Anderson, LaCrosse, Wisconsin.-"Comparisons between sand and sandy loam farms show marked differences in crop and livestock production, income and expenses as well as in other factors over the four-year period (1944-47, inclusive) covered in a study of 169 farm records from Waushara and Adams Counties.

"Crop yields were 23 per cent greater on the sandy loam farms than on the sand farms. Cropland in the former group consisted chiefly of soils such as Chetek, Goetz, Oneil and Scandia sandy loams. Plainfield and Coloma sands typified most of the soils in the sand group.

"The sand farms were at a greater disadvantage in corn and small grain production than in the yields of hay. Differences between the two groups of farms in corn silage yields, especially, were largely due to the fact that corn that failed to produce ear corn, in many instances, were ensiled.

Table 1.--Yield comparisons, average 1944-45-46-47.

	Sand 69 farms	Sandy loam 100 farms	Difference %
Corn	29 bushels	35 bushels	21
Oats	21 bushels	32 bushels	52
Rye	11 bushels	11 bushels	--
Wheat	13 bushels	19 bushels	46
Potatoes	90 bushels	91 bushels	1
Hay	1.4 tons	1.6 tons	14
Silage	4.3 tons	6.6 tons	54
Index	87	107	23

"The sandy loam farms averaged 25.7 units of productive livestock as compared with only 20.5 units for the sand farms. The greatest advantage of the former group was in dairy cow numbers and in total butterfat production per farm. The 27 per cent greater number of productive livestock units per 100 acres of cropland is an indication of the greater livestock carrying capacity of sandy loam farms than of the sand farms.

Table 2.--Livestock comparisons, average 1944-45-46-47

	Sand	Sandy Loam	Difference %
Dairy cows, no.	10.3	13.4	30
Other cattle, no.	11.0	13.1	19
Hogs, cwt.	40.0	45.0	12.5
Sheep, no.	4.2	1.4	- 70
Butterfat, lbs.	2540	3453	36
Eggs, dozen	1589	1559	- 2
Productive livestock units	20.5	25.7	25
Livestock units per 100 acres	17.5	22.3	27

"These two groups of farms were about equal in size, from the standpoint of crop acreages. However, on the basis of work load, the sandy loam farms were 20 per cent larger (483 days of productive work as compared with 403 days for the sand farms). The former group also had advantages in labor efficiency, efficiency of feeding and value of crops per crop acre. There was but little differences in butterfat production per cow and in feed purchases per livestock unit.

"Net earnings to the farm operator was \$962 or 55 per cent greater on the sandy loam farms. The net earnings per acre of cropland, therefore, was considerably greater for this group of farms than for the sand farm group.

Table 3.--Miscellaneous comparisons, average 1944-45-46-47

	Sand	Sandy Loam	Difference	%
Days productive work	403	483		20
Days productive work per man	225	283		26
Crop acres	117	115		- 2
Value of crops per crop acre	\$ 24	\$ 33		37
Feed purchased per livestock unit	\$ 30	\$ 29		- 3
Feed efficiency	\$152	\$168		9
Operator's labor earnings	\$1745	\$2707		55

"According to precipitation records at Hancock, growing conditions from the standpoint of the amount of precipitation in March, April, May and June were normal or above for all four years. July and August precipitation was about normal in 1944. The average rainfall for these two months of 1945 and 1946 was only about one-half of normal. The deficiency in 1946 may have been offset in part by the unusually heavy precipitation in June and September. About the normal amount of rain fell during these two months in 1947. All in all weather conditions, from the standpoint of crop production were slightly below normal for the 1944-47 period.

"These records need further summarization within each soil group to determine ranges and distribution of farms as far as crop yields, livestock production and income is concerned. Preliminary examination of the records indicate that crop yields, production and income are above average on only a few of the farms in the sand group. On the basis of these preliminary examinations, it would seem necessary to make drastic changes in farm size, land use, crop and livestock production patterns if material increases in income are to be realized. However, more detailed analysis will need to be made of this point before conclusions can be drawn. Further study of the effects of a soil conserving system of farming also is underway."

Tillage Practices in Relation to Wheat Yields - Harley A. Daniel, Guthrie, Oklahoma.—"Methods of tillage for wheat production are being studied at the Wheatland Conservation Experiment Station. The highest average yield of wheat to date from the continuous tillage on the plots at Cherokee has been produced on the plowed land. Yields have been lowest (Table 1) on the stubble mulch plots. The average yields on the listed and basin listed land have been the same, and they are only slightly less than on the plowed land. The mulched plots have consistently contained a heavy growth of cheat and weeds, and the wheat plants have been attacked by an infestation of foot rot each season beginning with 1944. During 1943 some straw worm damage was also observed on the mulched plots.

Table 1.--Effect of Different Methods of Continuous Tillage on Yields of Wheat, Cherokee, Oklahoma.

Method of Tillage	Yield of Wheat Per Acre(1)	
	Grain (Bushels)	Straw (Tons)
Plowed	19.9	1.52
Basin listed	19.2	1.47
Listed	19.0	1.46
Stubble Mulch	15.0	1.21

(1) Six years, 1942-47, Precipitation average 25.6 inches.

"The highest average yield to date on the watersheds has been produced on the one-way plowed land and the lowest on the stubble mulch areas (Table 2). The annual water loss in runoff from the watersheds was the highest from the one-way plowed land. Where the tillage methods were rotated, weeds, foot rot, etc., have not been a serious problem.

Table 2.--Effect of Different Methods of Rotated Tillage on Wheat Yields and Runoff Water, Cherokee, Oklahoma (1)

Method of Tillage (2)	Yield of Wheat Per Acre(3)		
	Grain Bushels	Straw Tons	Percent Runoff (4)
One-way Plowed	19.7	1.52	10.9
Basin listed	18.8	1.46	8.2
Stubble mulch	17.8	1.32	9.3

(1) For crop year (July 1 to June 30)

(2) Cultivated on contour.

(3) Average of six years 1942-47.

(4) Average of five years 1943-47.

"Therefore, it appears that in order to take advantage of moisture conditions a flexible system of tillage may be used. When soil moisture conditions are favorable following harvest, the crop residue may be worked into the topsoil. But if dry weather prevails, immediate one-way disking or other surface tillage would appear to be justified in the area represented by the station at Cherokee.

"For the higher, more arid section of Oklahoma, it may be necessary to introduce sorghum or fallow into the cropping system for controlling wind erosion. Under such conditions, methods of soil and water conservation, fertility maintenance and crop production must be developed in harmony with natural conditions. But in another report I have suggested a combination of tillage and crop successions which is flexible enough for the extreme annual variations encountered in the Southern Great Plains."

DIVISION OF DRAINAGE AND WATER CONTROL

Hydrologic Studies - L. L. Harrold, North Appalachian Experimental watershed, Coshocton, Ohio.--Mr. Schiff reports, "Some of the highlights from the paper entitled 'Water Movements Within Soil and Surface Runoff with Reference to Land Use' now being prepared, are as follows:

- a. Maximum transmission rates (linear velocity) of 20 inches per hour for cultivated crops and 40 inches per hour for forest allows water to move into and use the storage space in the topsoil. Little use is made of the storage space available in the subsoil because transmission rates are low, maximum being in the vicinity of 1.50 inches per hour for Muskingum silt loam and 0.83 for Keene silt loam.
- b. Rates and amounts of runoff of any significance occur only when the topsoil storage space is exhausted and rainfall rates exceed the percolation rates at the bottom of the topsoil. Percolation rates found during 1946 and 1947 have varied from a maximum to a minimum of 0.60 to 0.15 inch per hour respectively for Muskingum silt loam and from 0.46 to 0.04 for Keene silt loam.
- c. Theoretical initial transmission rates required in soil at a given soil moisture to absorb various infiltration rates are presented. For the storm of June 16, 1946, on watershed 123, it is shown that the topsoil could absorb a rainfall rate of about 4 inches per hour at the beginning of the storm and a rainfall rate of about 2.3 inches per hour at 9:06 p.m. when depression storage began. Actual rainfall rates were within this range until 9:06 p.m. After this time, the rate of rainfall increased to 2.88 inches per hour and detention storage or overland flow began at 9:10 p.m. It is believed that this type of information could lead to a classification of soils based on transmission rates.
- d. To absorb the rates of rainfall of from 4 to 5 inches that occurred on June 16, 1946, transmission rates would have had to be as high as 40 to 50 inches per hour on forested watershed 131. Preliminary analyses indicate a transmission rate of 37.5 inches per hour in the topsoil and 7.5 in the subsoil. Laboratory tests on core samples indicate a transmission rate of 43 inches per hour in the topsoil and 15 inches per hour in the subsoil. The difference between the theoretical transmission rate required, 40 to 50 inches per hour, and the rates actually occurring, 37.5 inches per hour, was the reason for the small amount of runoff."

Hydrologic Studies - J. A. Allis, Central Great Plains Experimental Watershed, Hastings, Nebraska.-"Disastrous floods in March were averted only through the kindness of Nature- On March 10, an accumulation of 13 inches of snow covered the frozen ground and with a few warm days or with a rain, either of which would be normal for this time of year, would have produced practically a 100 percent runoff. On March 11 the temperature dipped to an all time low for this season of the year of -16.6° and for the next 10 days the temperatures increased gradually and during the period the water from the melting snow thawed the ground and recharged the moisture content. Runoff was relatively small however, in several cases such as the little Blue River and Wood River were in flood stage on March 20, and 21st.

"On March 25 the temperatures reached a high of 76.2° followed by snow, sleet, rain, lightning, and thunder on the 26th with a maximum temperature of 30° and an average wind velocity for the day of 27.1 miles per hour. The 2-inch snow and sleet left on the ground melted on March 27 and 28th."

Hydrologic Studies - R. B. Hickok, Lafayette, Indiana.-"The writer called the attention of Dr. B. R. Bertramson, Station Collaborator, on March 18, to the fact that, whereas phosphorus loss determinations have heretofore included the 'total acid soluble', absorbed and organic fractions, no determinations of organic phosphorus have been included in recent analyses. In a meeting with Dr. Bertramson, Dr. Kohnke, and several other interested members of the Agronomy Department on March 25, it was decided that the importance of organic phosphorus losses in the runoff to the immediate productivity of the soil was problematical and probably dependent on the forms of organic matter prevalent in the runoff. It was further decided that until some basic study of this could be made, the routine determinations of phosphorus in the runoff would include only the 'total acid soluble' (modified Bray technique, No. 4) and the absorbed fractions, and that periodic samplings of organic phosphorus will be run. The writer raised a question also on the significance of total nitrogen, losses to maintenance of soil productivity, on the same basis. It was generally acknowledged that this also was problematical. These problems seem to point to an important need for (1) more basic information on the contribution of nitrogen and phosphorus to plant nutrition by various forms of organic matter, and (2) studies to learn the relative amounts of various forms of organic matter being carried in the runoff."

Hydrologic Studies - George A. Crabb, Jr., East Lansing, Mich.-"Precipitation for the month of March, as measured by the United States Weather Bureau type non-recording rain gages, at the project amounted to 4.09 inches for the cultivated watersheds, 3.66 inches for the stubble-mulch plots, and 4.08 inches for the wooded watershed. The 50-year average for East Lansing, as measured by the United States Weather Bureau, is 2.35 inches.

"There was runoff this month from all watersheds, as is shown on the following tabulation:

Date	Watershed	Precipitation (inches)	Runoff (inches)	Soil Loss (lbs./acre)
3/16	A	0.03	0.8239	19.790
3/16	B	.03	.7758	31.216
3/19	A	2.48	.6115	23.006
3/19	B	2.48	2.1049	330.212
3/19	W	2.69	.8842	27.253

"These runoffs were the to-be-expected spring break-up, and consisted of both rain, snow, and snow-melt. The break-up this year occasioned high water levels in streams throughout the State, but flooding was, on the whole, not nearly so severe as was found last year, when the floods were disastrous. Frost rapidly left the ground following precipitations of the latter part of the month. All trace of frost was out of the ground on March 27.

"On March 25 the project supervisor met with SCS Operations personnel, and representatives of the Michigan Department of Conservation, Agricultural Engineering Department, and Soil Science Department to hear a report on a new method of determining percolation rates in the soil devised by members of the Michigan and United States Geologic Surveys. In its elementary form, this method consists of sinking a series of test wells around a central well, and pumping a constant head of water from the central well, while keeping stage records in the test wells. This procedure promises to be of value in determining proper spacing for tile drains."

Hydrologic Studies - R. W. Baird, Waco, Texas.-"An extremely cold norther for March blew through March 11 and 12. Very little moisture, 0.04 inch, came with this storm and temperatures of +16 degrees F. were recorded March 11 and 12. This freeze severely damaged winter oats, clover, fruit, and vegetables. High winds accompanying the small rain of March 22 did some damage to roofs and buildings. The high winds of March 29 and 30 together with the dust were the worst since 1938. There was no drifting of soil in this locality except for a few fields in the Brazos river bottom.

"Some studies have been made on the amount of water retained on areas with conservation practices as compared to those with ordinary farm practices. The period from September 1946, through May 1947, is a good period for these observations. In September 1946, soil moisture was very low but by November it had built up so that there was some runoff from all areas and the soil was very wet at the end of May 1947. The monthly amount of rainfall retained and the cumulative total taken from rainfall and runoff records is shown in table 1. It is interesting to note the gradually

Table 1.--Watershed and Hydrologic Studies, Waco, Tex.

		Monthly and Cumulative Rainfall Minus Runoff Sept. 1946-May 1947														
		Conservation Practices : Conservation Practices : Ordinary Farm Practices : Ord. Farm Prac.														
Area :	Y	Y-Y-2	Y-2	Y-2-Y-4	Y-4	Y-10	W-1	W-2	W-2W-6W-1	W-6	W-10					
Size in:																
Acres :	309	177	132	52.1	79.9	21.0	176	130	68.0	42.3	19.7					
1946																
Sept.	4.208	4.092	4.364	4.228	4.453	4.661	3.213	3.513	3.496	3.570	3.450					
Cum.	4.208	4.092	4.364	4.228	4.453	4.661	3.213	3.513	3.496	3.570	3.450					
Oct.	1.591	1.593	1.588	1.580	1.593	1.607	1.667	1.874	1.872	1.870	1.890					
Cum.	5.799	5.685	5.952	5.808	6.046	6.268	4.880	5.387	5.368	5.440	5.340					
Nov.	4.647	4.706	4.568	4.579	4.561	4.261	4.673	4.679	4.481	5.075	4.513					
Cum.	10.446	10.391	10.520	10.387	10.607	10.529	9.553	10.066	9.849	10.515	9.853					
Dec.	1.888	1.841	1.951	1.845	2.020	1.997	1.812	1.518	1.190	2.046	1.515					
Cum.	12.334	12.232	12.471	12.232	12.627	12.526	11.365	11.584	11.039	12.561	11.368					
1947																
Jan.	1.710	1.692	1.734	1.062	2.172	1.946	2.093	1.592	1.070	2.754	.899					
Cum.	14.044	13.924	14.205	13.294	14.799	14.472	13.458	13.176	12.109	15.315	12.267					
Feb.	.509	.478	.550	.530	.563	.569	.480	.206	-.077	.516	.518					
Cum.	14.553	14.402	14.755	13.824	15.362	15.041	13.938	13.382	12.032	15.831	12.785					
March	2.428	2.353	2.529	2.034	2.852	3.024	3.008	2.312	1.687	3.325	2.292					
Cum.	16.981	16.755	17.284	15.858	18.214	18.065	16.946	15.694	13.719	19.156	15.077					
April	2.616	2.571	2.676	2.661	2.686	2.663	2.611	2.422	2.099	2.884	2.546					
Cum.	19.597	19.326	19.960	18.519	20.900	20.728	19.557	18.116	15.818	22.040	17.623					
May	3.263	3.220	3.321	3.100	3.465	3.340	3.118	3.097	2.769	3.772	2.778					
Cum.	22.860	22.546	23.281	21.619	24.365	24.068	22.675	21.213	18.587	25.812	20.401					

* A relatively large seepage flow from this area and the small amount of rainfall for the month doubtless causes this negative amount.

increasing amount of rainfall retained on the Y areas with conservation practices as the headwater areas are reached. This is probably due to the increase in the amount of seepage or low water flows in the larger areas. Although there is some indication of less runoff and more of the rainfall retained on the land in the areas with conservation practices during this period the results are not conclusive and much more study on this subject is needed.

"Considerable time was spent during the month on studies of flood frequencies and magnitudes. A 5-year record, 1939-43, is available for most areas when all areas had ordinary farm practices. Using the probability method developed by Prof. E. J. Gumbel, the curves for this period are almost identical with those for a 10-year period for areas W-1 and W-2. These two areas were continued without a change in the cropping plan (1938-47). More work is needed on this study but preliminary results are encouraging."

Farm Ponds - T. W. Edminster, Blacksburg, Virginia.-"During the month of March, compaction-moisture curves were obtained for 10 soils under 5 different applied loads (50, 100, 150, 200, and 250 lbs. per square inch). Also a graph of optimum soil moisture versus maximum volume weight for the data obtained under 250# per square inch load has been prepared. It is of interest that R. R. Proctor's data, including 30 samples, plots on a curve almost identical with the project's curve.

"Percolation tests are proceeding very slowly. Tests are run using three mantle thicknesses (6, 12, and 24 inches) after being compacted under three different loads (50, 100, and 150 pounds per square inch). Considerable difficulty is being encountered in getting the water out of the sample in order to compact it at optimum moisture. Thus far best results have been obtained by first applying the desired load then draining overnight over 60 cm tension and again applying desired load the next day. This is very time consuming but it appears to be the only safe way. Any excess moisture very evidently does not permit maximum compaction. Four soils remain to be tested in this respect."

Runoff Studies - N. E. Minshall, Madison, Wisconsin.-"Precipitation at Edwardsville for the month was 5.56 inches as compared with a normal of 3.40 inches. Most of this amount fell in the last 10 days and was generally at moderate intensities and there were no high rates of runoff. The total runoff for the month for the 50-acre pastured watershed was 2.25 inches. Temperatures varied from a maximum of 79 degrees on the 20th to a minimum of -6 on the 12th, with a mean of 38 degrees or about 6 degrees below normal.

"Precipitation at Fennimore was 2.08 inches, which was very nearly normal. Over one-half of this amount came in the form of snow. All the snow which was on the ground melted during the period of March 14 to 16, with a resulting total runoff from all watersheds about 1 inch. Temperatures varied from a maximum of 69 degrees on the 25th to a minimum of 12 below on the 11th, with a mean of 29 degrees, which is only slightly below normal.

"The report on rates of runoff for the design of conservation structures in the Upper Mississippi Valley upland loessial areas, which was based on the Fennimore studies, was sent to the Illinois, Iowa, Minnesota, and Wisconsin Agricultural Experiment Stations on March 4. It has already been cleared by the Wisconsin Station but no replies have been received from the others as yet."

Drainage Studies - M. H. Gallatin, Homestead, Florida.-"Owing to little rainfall, by the middle of the month all of the blocks located in lime groves showed by the readings that the trees had reached the wilting point. The avocado which has a waxy leaf does not show the effect of lack of moisture as quickly. Our readings at the middle of the month showed that the avocado groves in which we had our blocks had reached the wilting point but this was not apparent visually until two weeks later. Our work to date with our moisture equipment shows that we can determine very accurately the point of need for irrigation.

"Moisture readings taken in our mulch plots have shown a steady increase for this period of dry weather. The increase has been in the following order: check, natural cover, pine straw, grass and shavings. During this period the shavings mulched plot has not lost moisture nearly so fast as the other plots.

"In general there has been no increase in the chloride concentration for the Miami area for this period. In a few cases the indications are that there might be an increase if or dry weather continues.

"Samples collected in the Homestead area from the Goulds, Military, and North Canals show a definite rise in concentration for the area east of the structures. There has been an increase in concentration along the Military Canal a mile west of the structure. The cause is not definitely known except that the type of ditches and excessive pumping may have allowed the salt to come into this area. Ditches in this area are dug into the rock, so as to remove the water from this area they have had to pump large quantities of water. Indications for the Homestead area are that the concentration will increase in the North Canal area."

Supplemental Irrigation Studies - James Turnbull, Lake Alfred, Florida.-"Progress is being made in setting up the experimental irrigation plots on the County Farm at Fort Pierce. Plot layouts have been agreed on, which call for five irrigation treatments. Valencia orange plots will be set up in triplicate on Parkwood soil and in duplicate on Sunniland soil. Marsh grapefruit plots also will be set up in triplicate on Parkwood soil and in duplicate on Sunniland soil. The five treatments are:

1. Maintained high moisture content by spray irrigation
2. One-inch spray irrigation, as required
3. Two-inch spray irrigation, as required
4. Irrigation by flooding middles, as required
5. No irrigation.

"Perforated, portable irrigation pipe has been secured but the pumping plant is not available yet for this work.

"There is considerable interest among growers as to whether irrigation can be justified at present fruit prices. Analysis of our yield data from last year indicates that irrigation of Valencia oranges is profitable if the oranges sell for at least 50 cents a box on the tree. Irrigation of Marsh grapefruit is profitable if the grapefruit sell for at least 25 cents a box on the tree. Valencia oranges are bringing about 50 cents a box on the tree at present but Marsh grapefruit are only bringing 10 cents a box or less, and it is estimated that 10 million boxes of grapefruit will be left on the trees when picking operations are concluded for the season."

Drainage Studies - T. W. Edminster, Blacksburg, Virginia.-"During March Mr. Walter L. Turner, Jr., Soil Scientist, together with Mr. Forrest Steele, Survey Supervisor, and other field personnel, sampled Sites 94 through 97, which included Loyd loam, Atlee very fine sandy loam, Wickham loamy fine sand, and Helena sandy loam. On all samplings the 3-inch and 4-inch cylinders were used concurrently with both driving and jacking. Upon completion of the laboratory determinations, further study will be made of the comparative results as a guide to final selection of equipment type for Region II.

"Methods of comparison of water table draw-down and soil permeability were started. Methods used by Dr. T. C. Peele, SCS, Clemson, S. C., and Mr. W. W. Donnan, SCS, El Centro, Calif., require the amount of water removed from the soil per some unit of time. Precipitation, temperature changes, and other factors make it impractical to determine on a weekly basis the rate of water removed from the soil.

"Since lack of funds to keep engineer near equipment makes it impossible to get more frequent records, equipment is now being constructed which

is intended to record the time and length of each pump operation. Accurate calibration of pump discharge will make possible the determination of rate of water removal from soil.

"The development of a root cutting device to be used with ditching machines made its most rapid advance during the month. Present results indicate that there are two possible types of device that may be developed: Pneumatic tools and mechanical tools.

"The pneumatic tools consisting of pneumatic vibrator tool, air storage tank, and air compressor cost considerably more than the mechanical tools. Mechanical tools consist of oscillating saw head, chuck, flexible shaft, and either electric motor or gasoline engine. The following table gives the results of preliminary survey of construction costs:

<u>Pneumatic Tools</u>		<u>Mechanical Tools</u>	
Compressor	\$81.00	Engine (on 2-wheel truck with	
Tank ^{1/}	309.00	7 ft. flexible shaft)	\$235.00
Tool	45.40	Saw and chuck (about)	50.00
Total ^{2/} (F.O.B. Factory)	\$435.40	Total	\$285.00

^{1/} The volume of air required by the tool was not made clear by the manufacturer. This figure is based on volume of free air. For compressed air, the tank, as bid by one company, costs \$910.00 f.o.b. factory.

^{2/} Price of pipe fittings and hose not included."

Supplemental Irrigation Studies - J. R. Carreker, Athens, Ga.-

"The 1947 vegetable plots data statistical analyses were made with the help of and according to the procedure prescribed by Dr. Henry Hopp. The plot yield summaries, conclusions, and the analyses of variance are given in the following tables:

Table 1.--Summary of bean yields, 1947

	Irrigated	Unirrigated
	Avg. yield in Lbs/Subplot	
Fumigant 1	31.2	20.6
Fumigant 2	37.1	22.1
Fumigant 3	40.0	19.9
None	33.1	19.1
Multiplied by .165.9 for lbs/acre		

Conclusions:

1. Irrigation on both the treated plots and the untreated plots significantly increased the yield.
2. Fumigants 2 & 3 significantly increased the yield with irrigation over no treatment and treatment with fumigant 1.
3. Fumigants without irrigation did not give significant increases.

Table 2.--Analysis of variance
1947 pole beans

Source	D.F.	Sum of squares	Mean sq. or variance	F	Required		
A. Fumigant Treatment	1	34.68	34.68	.	5%	1%	D.F.
B. Irrigation on Treated Plots	1	1395.37	1395.37	61.17**	4.26	7.84	1:24
C. Irrigation on Untreated Plots	1	390.60	390.60	17.12**	4.26	7.82	1:24
D. Fumigants-Unirrigated Plots							
(1) Fum 2 vs. Fum 1 & 3	1	8.76	8.76				
(2) Fum 1 vs. Fum 3	1	.78	.78				
E. Fumigants-Irrig. Plots							
(1) Fum 1 vs. Fum 2 & 3	1	143.07	143.07	7.39*	4.75	9.33	1:12
(2) Fum 2 vs. Fum 3	1	17.11	17.11				
F. Replicates	24	547.54	22.81				
TOTAL	31	2537.91					

Analysis of replicates:

(1) Plots	6	204.72	34.12	
(2) Treatment & Plots	6	110.38	18.39	
(3) Fumigants & Plots	12	232.44	19.37	Error for (d) & (e)
TOTAL		547.54		

Table 3.--Summary of okra yields, 1947

Chemical	Irrigated	Unirrigated
	Avg. yields	per subplot
D-D, Avg. of Fumigants 1 & 2	62.9	43.2
Ethylene-Dibromide, Fumigant 3	55.4	36.1
Untreated, no fumigant	46.9	30.9
	(Multiply by 165.9 for lbs/ac)	

Conclusions:

1. Irrigation increased the yield significantly when the soil was treated.
2. Irrigation did not increase the yield significantly when the soil was not treated.
3. Fumigants 1 and 2 significantly increased yields with irrigation and without irrigation.
4. Fumigant 3 increased the yield, but not significantly, on both irrigated and the unirrigated plots.

Note: With okra the increase was uniform, and not significantly higher with irrigation, as was the case with the tomatoes.

Table 4.--Analysis of Variance
1947 okra

Source	D.F.	Sum of squares	Mean sq. or variance	F	Required		
					5%	1%	D.F.
A. Treatment (fumig. vs none)	1	825.43	825.43	5.26*	4.26	7.82	1.24
B. Irrigation on Treated Plots	1	2281.50	2281.50	14.53**	4.26	7.82	1.24
C. Irrigation on Untreated Plots	1	510.40	510.40	3.25	4.26		
D. Unirrigated							
(1) Fumig. 3 vs F 1 & 2	1	136.33	136.33	5.23*	4.75	9.33	1.12
(2) Fumig. (1) vs (2)	1	93.84	93.84	3.60	4.75		1.12
E. Irrigated							
(1) Fumig. 3 vs F 1 & 2	1	151.00	151.00	5.79*	4.75	9.33	1.12
(2) Fumig. 1 vs 2	1	1.38	1.38				
F. Replicates	24	<u>3767.11</u>	156.96	Error for a, b, c			
TOTAL	31	7766.99					

Analysis of Replicates:

(1) Plots	6	2620.03	436.67	
(2) Plots & Treat Tr vs None	6	834.03	139.00	
(3) Plots & Fumig.	12	<u>313.05</u> <u>3767.11</u>	26.09	Error for d and e

Table 5.--Summary of Tomato Yields, 1947

Chemical		Irrigated Yields in lbs.	Unirrigated per subplot
DD	Avg. F1 & F2	234.0	195.0
Ethylene-DiBrom	Fumigant 3	230.7	147.4
	None	142.0	138.0
		Multiply by 197.6 for lbs/acre	

Conclusions:

1. Irrigation increased the yield significantly when the soil was treated.
2. Irrigation did not increase the yield significantly when the soil was untreated.
3. Fumigants 1 and 2 increased the yield significantly both with and without irrigation; the two fumigants appeared to give approximately similar results.
4. Fumigant 3 increased the yield only with irrigation.

Table 6.--Analysis of Variance
1947 Tomato

Source	D.F.	Sum of squares	Mean sq. or variance	F	Required	
					5%	1%
A. Fumigant Treatment	1	26,563.5	26,563.5	17.274**	4.26	7.82
B. Irrigation on Treated Plots	1	17,832.5	17,832.5	11.60**	4.26	7.82
C. Irrigation on Untreated Plots	1	28.5	28.5	.018		
D. Fumigants-Unirrigated Plots						
(1) Fum. 3 vs 1 & 2	1	6,064.26	6,064.26	11.95**	4.26	7.82
(2) Fum. 1 vs 2	1	0.66	0.66			
E. Fumigants Irrigated Plots						
(1) Fum. 3 vs 1 & 2	1	28.61	28.61			
(2) Fum. 1 vs 2	1	508.80	508.80	1.002	4.26	7.82
F. Replicates	<u>24</u>	<u>36,906.44</u>	1,537.77	Error for a, b, c		
TOTAL	31	87,933.27				

Analysis of Replicates:

(1) Plots	6	25,636.93	4,272.82	
(2) Treatment Plots (Fumigation vs none)	6	5,177.99	862.998	
(3) Fumigants Plots	12	<u>6,091.52</u>	507.63	Error for (d) & (e)
TOTAL		36,906.44		

IRRIGATION DIVISION

Water Requirements in Irrigated Areas - Upper Colorado River Basin - Harry F. Blaney, Los Angeles, Calif.-"A provisional report on 'Tentative Estimates of Consumptive Use of water Rates in the Upper Colorado River Basin' was completed. The report includes preliminary estimates of use of water by alfalfa, wild hay, beans, corn, and other agricultural crops and dense, medium, and sparse natural vegetation in about 50 locations. The report was presented to the Engineering Advisory Committee of the Upper Colorado River Basin Compact Commission for review at Denver on March 25 and 26, 1948. Those attending the meeting included representatives of the State Engineers of Arizona, Colorado, New Mexico, Utah, and Wyoming; and of the Bureau of Reclamation and the Soil Conservation Service. The report was tentatively approved by the Committee after some discussion, and plans were formulated to inspect the irrigated areas in the basin in May."

Irrigation and Rainfall Penetration Studies in Upper Santa Ana River - Dean C. Muckel, Pomona, Calif.-"A field trip over the Yucaipa area was made in company with a member of the San Bernardino County Flood Control District in preparation of selecting orchards for soil moisture studies during the coming irrigation season. Practically all irrigation water used in the valley is supplied by mutual water companies. The offices of the four principal companies were visited to obtain irrigation schedules and copies of their rules and regulations. It was learned that most of the companies have agreed on a 28-day schedule this season as a trial to conserve water. Heretofore, some were on a 21-day schedule."

V. S. Aronovici, Pomona, Calif.-"As has been previously discussed in monthly progress reports, field capacity appears to be more a function of moisture transmissibility under falling moisture content. That is, when the permeability of the soil reaches a point where further movement is extremely small, the moisture remaining in the soil is field capacity. The question then arises, are the desorption curves obtained a function of permeability and if so, how? This problem entails the nature of water removal from a soil core upon a tension table. In order to secure some light on this point a cylinder was constructed with a series of thin tabular tensiometer cups. These cups were connected to mercury manometers. The cups were placed 0.5, 2.0, 3.5, and 5.0 centimeters above the base of the soil column. Soil was then placed in the cylinder and saturated. Tension of 15 centimeters mercury was then applied to the soil. The following tabulations are tensions observed. These values were corrected to a common reference point and corrected for the water column above the mercury.

Run No. 3 -- Hanford Sand at 15 centimeters
mercury tension

Elapse time	Tensiometer # 1	Tensiometer # 2	Tensiometer # 3	Tensiometer # 4
Hours	cm. Hg. 1/	cm. Hg. 2/	cm. Hg. 3/	cm. Hg. 4/
0.0	-0.61	-0.80	-1.46	-0.66
0.25	-0.33	-0.42	-0.65	-0.07
0.50	+0.48	+0.32	+0.47	+0.95
0.75	1.33	1.12	1.65	1.86
1.00	2.16	1.85	2.65	2.86
1.25	2.97	2.56	3.48	3.70
1.50	3.54	3.11	4.09	4.23
2.00	4.54	4.13	5.05	5.16
4.00	7.32	6.84	7.37	7.24
7.00	10.28	9.77	9.92	9.77
21.00	13.82	13.98	13.44	13.13
26.00	14.50	15.16	15.19	13.94

1/ Tensiometer 1 is 0.5 cm. above porous plate.

2/ Tensiometer 2 is 2.0 cm. above porous plate.

3/ Tensiometer 3 is 3.5 cm. above porous plate.

4/ Tensiometer 4 is 5.0 cm. above porous plate.

"Although it was impossible to make observations precisely, tensiometer readings and subsequent corrections were accurate to 0.05 centimeters. Note that tension rose about the same throughout the entire soil column. The conclusion would, therefore, be that the moisture removal took place uniformly throughout the 5.5 centimeter soil column. It will now be necessary to utilize greater distances between the tensiometer cups so that any differences in tension will be more marked. Error may have entered the study by using a 3 mm. manometer tube, this requiring too large displacement of water through the cups. However, this study does indicate that, in soil columns of 5 centimeters or less in length, moisture removal under a specific tension may be nearly uniform. Several other runs were made on light and heavy-textured soils with results similar to those tabulated."

Drainage of Irrigated Lands - Imperial Valley - Harry F. Blaney, Los Angeles, Calif.-"Research studies on tile drainage, irrigation practices, East Mesa water-table, and evaporation from Salton Sea were continued in Imperial Irrigation District by W. W. Donnan and George D. Bradshaw. Dr. H. H. Bennett spent 2 days in the Valley reviewing the field work and inspecting farms that had been recently drained. One of the farms visited included 160 acres of barley and flax which had been tiled during the past

year. The farmer reported that the yield of barley was increased from 20 to 40 bushels per acre and the yield of flax from 28 to 40 bushels per acre as the result of tile drainage, releveled land, and improved irrigation practice. The farmer stated that the increased value of yields for the year will more than pay for the cost of tile installation."

Replenishment of Irrigation Storage in Deep Underground Aquifers - A. T. Mitchelson, Dean C. Muckel, H. K. Rouse.-Installation of the concentric ponds at the Wasco site for the study of the effect of air entrainment and lateral subsurface flow was completed to an extent permitting the testing of the water-tightness of the boundary plates beginning on March 11. The installation proved entirely satisfactory and no leaks through or under the boundary plates were detected. With no interruption, water was introduced into the inner pond on March 13 and the tests have been in continuous operation since that time.

The rates of percolation noted in the inner plot which is protected by the annular buffer plot show a slight resemblance to the rates noted on the original plot #19. This plot was operated under a low head of water varying from about 0.2 foot to 0.4 foot. The rate of percolation at the start on 6/12/45 was 2.15 feet per day. The rate gradually increased to 5.75 feet per day on July 17 and then declined to 2.80 feet per day on August 16, and to 1.65 feet per day on September 16, 1945. Thus, the period of time when the rate was increasing was 35 days and the period of time from the maximum to the same rate as at the start was approximately 45 days.

The new inner plot is the same size as original plot #19, though circular instead of square. Owing to drought conditions resulting in a very low soil moisture content, approximately 2.10 percent, the grass had not developed any new growth, while at the time plot #19 was started it was covered with a good growth of native grass. As far as possible, the surface of the plots was not disturbed during construction. On the inner plot, the initial rate of percolation was 4.53 feet per day on March 14, 1948. The rate increased to a maximum of 6.89 feet per day on March 24 and had receded to slightly less than the initial rate on March 31. It is noted that the period of increase was 11 days and the time required for a drop to the initial rate was but 7 days. This plot has been operated under a constant head of about 0.45 foot to 0.50 foot.

The rate of percolation through the soil of the outer buffer pond has remained close to 65 percent of the rate in the inner pond except for the first few days. Both ponds attained their maximum rates on the same day but the rate in the outer pond had declined to its initial rate in only 5 days.

It is to be regretted that this test was carried on without adequate replication. Unfortunately, the supply of water available at this time does not permit the addition of replicate plots. This may be possible at a later date when the demand for water for irrigation is less insistent.

John S. James, Billings, Montana.-"In Research, relationships between monthly average temperature and consumptive use were tentatively determined. These relationships will be checked by application to watersheds for which there are available records of water loss as indicated by the difference between annual precipitation and annual runoff. Present indications are that monthly ground surface evaporation during the dormant season varies directly with the square of the average temperature. Total consumptive use during the growing season appears to vary directly with the heat units (degrees x time) modified by 'possible sunshine' as determined by latitude and season.

"In both of these relationships temperature is expressed in degrees F. above zero. The use of zero as a base was determined empirically. With trial of different temperature bases zero was found to give the most consistent relationships. In the case of ground surface evaporation this consistency is indicated as conformity with a parabolic curve. For total consumptive use during the growing season the relationship is indicated to be a straight-line function.

"As one main purpose of this study is to provide, if possible, a working relationship based only on monthly climatic records, the 'growing season' has to be defined in terms of such limited records. The months during which vegetative growth makes material demand on moisture are, - tentatively, - assumed as those with average temperature 40° or above in the spring and 45° or above in the fall. This seems to conform fairly well with more precise definitions of the growing season if consideration is given to the different characteristics of vegetative growth at the beginning and at the end of the season."

Snow Surveys and Water Supply Forecasting - James C. Marr, Boise, Idaho.-"A good deal of interest developed during March concerning the water supply in parts of Columbia Basin. It had been reported at the end of January and again at the end of February that the winters' snow pack was deficient in Southeastern Oregon and Southwestern Idaho. These areas together with Central Oregon have formed the northern extremity of a belt extending southward through Nevada, California, and Arizona where severe drought is indicated by below normal precipitation and dirth of mountain snow cover. The end of March snow surveys are looked to for further and more definite information regarding this drought condition. Many requests have been received for copies of the Columbia River Basin Snow Surveys and Water Supply Forecast Report which is scheduled to be released April 10, 1948. This report will contain the final estimates for the year of the runoff that may be expected.

"The U. S. Bureau of Reclamation regional offices at Denver, Colorado and Boise, Idaho are seeking the best possible water forecast procedure for Boise River watershed, Idaho. It is found urgent to forecast accurately the runoff of this stream to avoid damaging floods such as occurred in 1943 and to provide sufficient water to irrigate some 356,000 acres of land in Boise Valley. After examining the forecast procedures developed of the U. S. Weather Bureau and the Corps of Engineers and formulating numerous runoff relationships they have requested and have accepted as the best the forecast procedure of the Boise, Idaho Office of Division of Irrigation, Soil Conservation Service."

Consumptive Use of Water Studies in Utah.-Messrs. D. K. Fuhrman and W. D. Griddle established an evapo-transpiration station at Vernal, Utah. Six double tanks were used for growing crops. Four of these tanks were 3 feet in depth and 4 feet deep and the other two were 24 inches in depth and 5 feet deep. Alfalfa growing in place was used in two of the tanks, pasture in two and the remaining two will be planted to wheat at about the time wheat is planted in the fields in the vicinity. The purpose of this study is to measure the consumptive use in the Uinta Basin Areas of Utah. In addition to the tanks used for growing crops a standard Weather Bureau type evaporation pan, an anemometer and a hydrothermometer were established at the station. This is in addition to the maximum and minimum thermometers and the standard rain gage already in operation in that area. Also sometime was spent with Mr. H. E. Thomas of the Ground Water Division, U. S. Geological Survey in looking over the Ashley Valley and determining locations for wells in which to measure fluctuations in the ground-water table. The entire Ashley Valley is to be studied as an inflow-outflow area. The variations in ground water table, the precipitation and all of the inflow and outflow of water to the Areas will be measured. Also there will be a complete land-use map made of all the land within the boundaries of the area. To these classifications will be applied unit values of consumptive use.

Snow Surveys - Carl Rohwer, Fort Collins, Colo.-"Snow Surveys and Irrigation Water Supply Forecasts were published for the Colorado, Missouri-Arkansas and Rio Grande drainage basins following the March 1 surveys. Releases covering the information in these reports were prepared for the Information Office of Colorado A and M College and the agricultural extension editors of New Mexico and Wyoming. These releases received generally favorable radio and newspaper coverage.

"A summary of the results of the snow course measurements on the Colorado River drainage for the period 1936-47 was published as Miscellaneous Paper No. 383 by the Colorado Agricultural Experiment Station. Arrangements are practically completed for the Colorado River Water Forecast Committee meeting at Reno, Nevada, April 15, 1948."

Miscellaneous Irrigation Studies - Dean W. Bloodgood, Austin, Texas.--"On a recent trip to West Texas and Southern New Mexico areas with Mr. H. A. Beckwith, Member of Texas Board of Water Engineers and our cooperator, a number of proposed dam sites, irrigation and water conditions were inspected.

"We went to proposed Boquillas Canyon dam site on Rio Grande but could not drive near to it to make an inspection. It is one of the sites that has been considered in the proposed dam sites on the Rio Grande.

"On Alamito Creek (Big Bend area) we inspected artesian wells used for irrigation purposes. The wells were drilled from 600 to 1,100 feet and flows from about 20 to 65 g.p.m. The water is warm and contains about 320 ppm. of total dissolved solids. The known artesian basin is about 15 miles long but it has never been explored or reported upon. Alamito Creek has a normal discharge of 20,107 acre-feet which could be used for irrigation purposes. San Estaban Dam is on Alamito Creek.

"The Fort Quitman area (about 81 miles below El Paso) on the Rio Grande was also visited. Many acres of new land are being broken up and put into cultivation. The water problems for irrigation are very serious. The Rio Grande was practically dry and the only flow noticeable was drainage water from underground drainage to drainage canals (water sample obtained but analyses not completed at writing of this report). The water being used was very salty. One of the drains near the Fort Quitman gaging station was discharging about 20 second-feet into the Rio Grande. The water is usually pumped from the river to the irrigated land. Cotton and some alfalfa appeared to be the principal crop. A new method for preparation of seed bed for cotton was noticed. It is locally known as the 'melon seed bed' and consists of a broad, flat ridge (several feet in width) with a small irrigating furrow on each side of it. The cotton is planted on the ridge. This method is entirely opposite to the usual practice in the Pecos Valley where water of high salinity is used to irrigate cotton. Here the cotton is planted in the bottom of the furrow.

"At El Paso, we contacted officials of the Bureau of Reclamation and were told that the available water supply stored at Elephant Butte and Caballo Dam would be prorated at the rate of 0.5 acre-foot per acre of irrigated land. However, the officials of the Bureau and others presented figures showing the amount of snow on the upper watersheds was above normal and should increase the flow and fill the reservoirs if climatic conditions were favorable. The amount of water stored at the two dams amounted to a little less than 600,000 acre-feet. We visited Elephant Butte Dam and the water was the lowest I had ever seen it.

"En route to Elephant Butte Dam we contacted my old co-workers and friends at New Mexico Agricultural Experiment Station. I hardly knew the Mesilla Valley--so many improvements and changes had been made. Land that could be bought several years ago for \$100 to \$150 an acre is now selling at \$600 to \$700 an acre. I was told cotton returned \$265 an acre--no wonder for the high prices.

"We also visited Carlsbad Project in New Mexico and noted water and agricultural conditions. We were told by Mr. H. H. Kidder, now Superintendent of the Project, and formerly a member of our irrigation staff in Texas, that the available water in storage at Alamagordo, McMillan, and Avalon Dam would be prorated at the rate of 0.4 acre-foot per acre. The prospects for increased flow from snow on the upper watersheds is less than that on the Rio Grande. He estimated they would have about a foot of snow to depend upon. Climatological conditions must also be favorable for a good runoff. The amount of water storage at Alamagordo, McMillan, and Avalon Reservoirs is about 30,000 acre-feet.

"Water and irrigation conditions in the Pecos Valley area of Texas were not so bad as the water users are depending more on underground water supply from wells than from stored or gravity water. The amount of water in storage at Red Bluff Dam was about 30,000 acre-feet. A portion of this amount together with water from wells drilled along the main canals furnish a sufficient amount that would be available for the first irrigation for cotton.

"The farmers of the Pecos Valley area are not depending very much on the small amount available from Red Bluff Dam. Instead, new land is being developed for irrigation in an area between Pecos and Balmorhea and between Imperial and Fort Stockton.

"There are about 25,000 acres of new land being irrigated from wells in the Pecos area. The wells are drilled from 170 to 300 feet or more in a thick stratum of water bearing gravel. The old wells that had been drilled in the area did not go deep enough to produce the big supply of water. Some of the wells have a capacity of 2,000 to 3,000 g.p.m. The farmers speak of sections instead of acres. Two to four wells per section will supply sufficient water for the irrigation of crops (principally grain and cotton crops). The cost of the raw land is as high as \$40 per acre and improved land about \$125 an acre. An insurance company, I understand, is financing most of the new projects. I am informed the quality of water is fairly good.

"Between Imperial and Fort Stockton, 17,000 acres of new land are being developed by pumping plants. Some of the water in this area is questionable as to its quality, but it is being used anyway."

Evaporation Studies - Dean W. Bloodgood. - "While in El Paso on my recent trip to West Texas, I discussed with representatives of the International Boundary Commission a proposed standard U. S. Department of Agriculture evaporation station near the head works of the Main canal of Maverick County Water Control and Improvement District No. 1, Eagle Pass. We already have installed a rain gage at this place. The Commission is anxious to cooperate with us but desire to establish the station near the new Falcon Dam they are planning to construct on the Rio Grande.

"While at Carlsbad the matter of a proposed evaporation station at Avalon Dam was discussed with Mr. Kidder, Superintendent of the Carlsbad Project. We have stored at Carlsbad most of the instruments needed for the installation of the station. These were formerly used in connection with our Pecos River Joint Investigations. Mr. Kidder desired to cooperate with us in establishing the station and as soon as arrangements are made for the construction of the three evaporation pans, the installation will be made.

"Mr. A. J. Gates, Engineer and Manager, Water Department, Wichita Falls, was in the office during the month and informed us the evaporation station at Lake Kickapoo was finally put into operation after some unavoidable delays.

"During my recent visit to West Texas areas I was interested in inspecting several climatological and evaporation stations. On a mountain ridge near the headquarters of the National Park Service in Big Bend National Park, I inspected a good standard Weather Bureau station consisting of maximum and minimum thermometers, a rain gage, and an anemometer.

"At Carlsbad the climatological station of temperature instruments, rain gage, and anemometer were established on a platform mounted on the ridge of the roof of a one-story building. This building was surrounded on one side by a higher building--not a standard installation.

"Near Balmorhea, the 6-foot diameter sunken evaporation pan at Texas Agricultural Experiment Sub-Station No. 9 was in bad condition. The salty water had eaten the metal entirely away near the rim of the pan and there was little metal left to support the rim. It was also noted the Weather Bureau evaporation pan showed sign of alkali action on the metal."

Infiltration Analysis - Stephen J. Mech, Prosser, Washington.-"Computations and compilation of last season's data is progressing quite rapidly. Plotting of the application and runoff for the 1947 irrigations have been made and the resulting infiltration curves established.

"The following are some of the results of this analysis:

1. Again the infiltration rate on established alfalfa showed progressive increase as the size of the furrow stream was increased. The infiltration has risen roughly 50 percent as the furrow stream was increased three times. This data substantiated previous results on alfalfa. It is felt that the influence of stream size on alfalfa is now conclusively established. The plots which are now in established alfalfa, showed no such increase when they were in row crops 2 years ago. In addition the average rate and indirectly the irrigating head, has been increased about three times by growing alfalfa for 2 - 3 years.

2. Infiltration drops rapidly for 2 - 3 hours after runoff begins.
The drop in infiltration rate is asymptotic.

"The following are rates of infiltration drop of 178 plot irrigations. Since the application rates were constant, changes in infiltration rates were reflected in runoff:

Table 1.--Average rate of decrease in rate of infiltration from approximately five hours after runoff starts to end of irrigation

7% furrow grade	0.005 inch per hour
2% furrow grade	.008 inch per hour

2 year old alfalfa (both 2% and 7% furrow grade)	0.006 inch per hour
4 year old alfalfa (both 2% and 7% furrow grade)	0.007 inch per hour

"Since the 2 percent furrow grade and the older stand had a greater infiltration rate it is not unreasonable that their rate should drop faster. Similar information is being obtained for the plots when they were in row crops.

Moisture Extraction by Wheat - Alfalfa - Stephen J. Mech.-"Soil moisture data obtained in connection with the establishment of alfalfa in wheat in 1944 has provided information on the moisture used by this combination of crops. This one year's data points out that this combination of wheat and alfalfa has a relatively high and sustained soil moisture requirement. The magnitude of this requirement is accentuated when one considers that it occurred at what is usually the cooler part of the growing season.

"Wheat and alfalfa were seeded on March 20. A total of 1.70 inches fell in April making a total of 5.09 inches for the period October 1943 - April 1944 inclusive. On the basis of soil moisture samples taken 2 days before irrigation and 2 days after the irrigation has stopped, the average soil moisture use per day was 0.30 inch for the 60-day period April 17 to July 16. This means a total of 18 inches of soil moisture were removed from the soil during the period. Peak periods average 0.33 inch and 0.36 inch per day, on the contour and downhill plots respectively.

"Though these data are primarily a measure of what happened under these particular conditions of the test, they do provide some information on the moisture need of spring wheat. In order to eliminate the shade and reduce further competition for food and water, the wheat was cut for hay while in milk stage. Subsequent irrigations were made for the alfalfa but the predominate vegetation was weeds and wheat. Since no soil moisture data were obtained after mid-July no further information is available on what took place after this time.

"The accompanying table shows the moisture conditions during the 60-day period as well as average moisture use during the period: Soil moisture data are average for 4-foot depth.

Table 2.--Initial and final soil moisture conditions for periods between irrigations and average moisture use between irrigations on 1944 wheat-alfalfa

Period	Days	Soil moisture during period in percent		Average use during period
		Initial	Final	Inches per day
2% Furrow grade				
April 17-June 8	22	19.3	9.3	0.33
June 11-June 26	15	19.2	14.4	.25
June 30-July 16	16	20.6	13.6	.30
Average		19.7	12.4	0.30
7% Furrow grade				
April 24-June 9	15	18.6	11.1	.36
June 13-June 27	14	19.5	14.6	.27
July 1 -July 17	16	19.8	13.0	.29
Average		19.3	12.9	.31
Grand Average		19.5	12.6	0.30

Moisture Extraction by Potatoes.-"The following table shows the soil moisture depletion by White Rose potatoes planted April 20 and harvested August 20, 1945. These data are based on soil moisture determination for 4-foot depths taken 2 days before irrigation and 2 days after irrigation has been stopped.

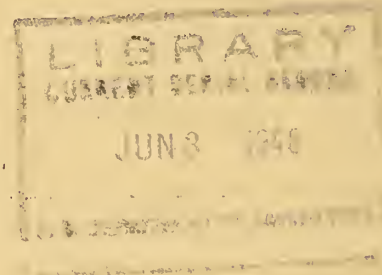
Table 3.--Initial and final soil moisture conditions for periods between irrigations and average moisture use between irrigations on 1945 potatoes

Period	Days	Soil moisture during period in percent		Average use during period
		Initial	Final	Inches per day
2% and 7% furrow grade combined				
April 16-June 8	52	17.1	13.2	0.08
June 12-June 20	8	16.4	14.2	.18
June 29-July 9	10	16.5	12.3	.30
July 14-July 23	9	16.4	12.2	.23
July 27-Aug. 4	7	17.0	14.0	.28
Average		16.7	13.2	.15

"Total extraction for the 111 days during the period April 16 - August 4 is equal to 16.65 inches.

"Values are for nine plots irrigated down a 7 percent slope and nine plots irrigated across the same slope at a furrow grade of 2 percent. There was no consistent differences in the moisture used by the two groups of plots.

"It is interesting to note though the total moisture used was not high and the average daily use for the season was only 0.15 inch per day, the month of July had an average use of about 0.27 inch per day."



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